Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of the claims in the application.

Listing of Claims:

1. (Currently amended) A qubit system, comprising: a qubit, the qubit including a multi-terminal junction coupled to a superconducting loop region thereby forming a superconducting loop, the superconducting loop region having a phase shift; and a controller coupled to the qubit, wherein the multi-terminal junction comprises a plurality of terminals.

2. (Original) The system of claim 1, wherein the multi-terminal junction includes at least one constriction junction.

3. (Original) The system of claim 1, wherein the multi-terminal junction includes at least one tunnel junction.

4. (Currently amended) The system of claim 3, wherein a tunnel junction in said at least one ~~the~~ tunnel junction is formed by an insulating layer separating ~~two of the at least two terminals~~ a first terminal and a second terminal in said plurality of terminals.

5. (Currently amended) The system of claim 4, wherein ~~the two of the at least two terminals are~~ said first terminal and said second terminal each comprise an s-wave superconducting material.

6. (Original) The system of claim 1, wherein the multi-terminal junction includes at least one two-dimensional electron gas structure.

7. (Currently amended) The system of claim 6, wherein a two-dimensional electron gas structure in the at least one two-dimensional electron gas structure is an InAs layer deposited on an AlSb substrate.

8. (Currently amended) The system of claim 1, wherein

the superconducting loop region includes a first portion of a s-wave superconducting material and a second portion of a s-wave superconducting material, and wherein

a portion of the phase shift is produced by a d-wave superconducting material, wherein said d-wave superconducting material is coupled to the first portion through a first normal metal interface and said d-wave superconducting material is coupled to ~~and~~ the second portion through a second normal metal interface ~~interfaces~~, and wherein

~~the~~ a portion of the phase shift ~~being~~ is determined by ~~the~~ an angle between the first normal metal interface and the second normal metal interface ~~and crystallographic directions in the d-wave superconducting material~~.

9. (Currently amended) The system of claim 1, wherein

the superconducting loop region includes a first portion of a s-wave superconducting material and a second portion of a s-wave superconducting material, and wherein a portion of the phase shift is determined by a difference in (i) a crystallographic direction of a first d-wave superconducting material and (ii) a crystallographic direction of a second d-wave superconducting material across a grain boundary interface between said first d-wave superconducting material and said second d-wave superconducting material, wherein

~~produced by a~~ said first d-wave superconducting material is coupled through a normal metal to the first portion of said s-wave superconducting material and ~~a~~

said second d-wave superconducting material is coupled through a second normal metal to the second portion of said s-wave superconducting material, ~~the portion of the phase shift being determined by the difference in crystallographic directions in a grain boundary interface between the first d-wave superconducting material and the second d-wave superconducting material~~.

10. (Currently amended) The system of claim 9, wherein the first d-wave superconducting material is formed on a first portion of a bi-crystal substrate and the

second d-wave superconducting material ~~are~~ is formed on a second portion of said bi-crystal substrate ~~insulating crystals~~.

11. (Currently amended) The system of claim 9, wherein the s-wave superconducting material is chosen from ~~a~~ the group consisting of aluminum ~~Aluminum~~, niobium ~~Niobium~~, lead ~~Lead~~, mercury ~~Mercury~~, and tin ~~Tin~~.

12. (Currently amended) The system of claim 9, wherein the first d-wave superconducting material and the second d-wave superconducting material each comprise ~~is~~ $YBa_2Cu_3O_{7-x}$.

13. (Currently amended) The system of claim 10, wherein the bi-crystal substrate is ~~insulating crystals can be chosen~~ selected from the group consisting of ~~Strontium Titanate~~ strontium titanate, ~~Sapphire~~ sapphire, ~~Cerium Oxide~~ cerium oxide, and ~~Magnesium Oxide~~ magnesium oxide

14. (Cancelled)

15. (Currently amended) The system of claim ~~14~~ 1, wherein the superconducting loop region includes a first portion and a second portion, the first portion and the second portion being coupled by ~~the~~ a ferromagnetic junction and wherein a portion of the phase shift is produced by said ferromagnetic junction.

16. (Currently amended) The system of claim 15, wherein the first portion and the second portion are each made of a s-wave superconducting material.

17. (Currently amended) The system of claim 16, wherein the s-wave superconducting material is ~~chosen~~ is selected from the group consisting of aluminum ~~Aluminum~~, niobium ~~Niobium~~, lead ~~Lead~~, mercury ~~Mercury~~, and tin ~~Tin~~.

18. (Currently amended) The system of claim 16, wherein the ferromagnetic junction is formed by copper or ~~Nickel~~ nickel sandwiched between the first portion and the second portion.

19. (Currently amended) The system of claim 16, wherein the ferromagnetic junction is ~~provided~~ formed by implanting a ferromagnetic material into the s-wave superconducting material between the first portion and the second portion.

20. (Currently amended) The system of claim 1, wherein the superconducting loop region is formed from a d-wave superconducting material having at least one grain boundary and wherein a portion of the phase shift is formed by said at least one grain ~~boundaries~~ boundary ~~in the d-wave superconducting material of the superconducting loop~~.

21. (Currently amended) The system of claim 1, wherein the controller is coupled to a first and second terminal in said plurality of terminals of the multi-terminal junction to provide transport current through the multi-terminal junction.

22. (Currently amended) The system of claim 1, wherein the controller ~~can~~ is configured to pass current symmetrically through the multi-terminal junction.

23. (Original) The system of claim 22, wherein the controller can perform a σ_x phase gate operation on the qubit by applying a pulse of current symmetrically through the multi-terminal junction.

24. (Currently amended) The system of claim 22, wherein the controller can tune the qubit by applying a constant current symmetrically through the multi-terminal junction in order to adjust a tunneling frequency between a first quantum ~~states~~ state and a second quantum state of the qubit.

25. (Currently amended) The system of claim 24, wherein the qubit is coupled to a plurality of other qubits thereby forming a qubit array, and wherein the controller tunes the qubit so that the tunneling frequency of the qubit substantially matches a tunneling ~~frequencies~~ frequency of ~~other~~ another ~~qubits~~ qubit in ~~a~~ said qubit array.

26. (Currently amended) The system of claim 1, wherein the controller ~~can~~ is configured to pass current asymmetrically through the multi-terminal junction.

27. (Currently amended) The system of claim 26, wherein the controller ~~can~~ is configured to initialize the qubit by passing current asymmetrically through the multi-terminal junction for a sufficient amount of time that a quantum state of the qubit becomes a preferred state.

28. (Currently amended) The system of claim 27, wherein the controller ~~can~~ is configured to initialize a first quantum state of the qubit by applying an initialization current asymmetrically through the multi-terminal junction in a first direction and ~~can~~ is configured to initialize a second quantum state of the qubit by applying current asymmetrically through the multi-terminal junction in a second direction wherein the second direction is opposite the first direction.

29. (Currently amended) The system of claim 26, wherein the controller ~~can~~ is configured to read a quantum state of the qubit by applying a read current asymmetrically through the multi-terminal junction and then measuring ~~a~~ for voltage across the multi-terminal junction.

30. (Currently amended) The system of claim 29, wherein the read current is greater than a critical current associated with a first quantum state of the multi-terminal junction ~~associated with a first state~~ and smaller than a critical current associated with ~~of~~ a second quantum state of the multi-terminal junction ~~associated with a second state~~, wherein

measurement of ~~the~~ a voltage across the multi-terminal junction indicates that the qubit is in the first quantum state and absence of ~~the~~ a voltage across the multi-terminal junction indicates that the qubit is in the second quantum state.

31. (Currently amended) The system of claim 26, wherein the controller ~~can~~ is configured to perform a σ_z phase gate operation by applying a pulse of current asymmetrically through the multi-terminal junction.

32. (Currently amended) The system of claim 1, ~~wherein~~ the system further comprising an external magnetic field source ~~can~~ that is configured to ~~be applied to~~ apply an external magnetic field source to the superconducting loop.

33. (Currently amended) The system of claim 32, wherein the external magnetic field source is configured to apply a phase gate operation on the qubit ~~can be performed~~ by application of the external magnetic field.

34. (Currently amended) The system of claim 32, wherein the external magnetic field source is configured to provide ~~provides~~ the phase shift in the superconducting loop of the qubit.

35. (Currently amended) The system of claim 1, further including a readout mechanism coupled with said multi-terminal junction, wherein said readout mechanism is configured to ~~for reading~~ read a quantum state of the qubit.

36. (Currently amended) The system of claim 35, wherein the readout mechanism includes a radio-frequency single electron transistor electrometer.

37. (Currently amended) The system of claim 35, wherein the readout mechanism includes a magnetic force microscope.

38. (Currently amended) The system of claim 35, wherein the readout mechanism includes a superconducting loop.

39. (Currently amended) The system of claim 35, wherein the readout mechanism includes a Hall probe.

40. (Currently amended) The system of claim 1, further including ~~a second~~ an auxiliary qubit, the ~~second~~ auxiliary qubit coupled to the ~~first~~ qubit through an entanglement junction.

41. (Currently amended) The system of claim 40, wherein the entanglement junction includes a second multi-terminal junction and a plate ~~in proximity with the~~ that is capacitively coupled with the second multi-terminal junction.

42. (Currently amended) The system of claim 41, wherein the plate capacitively couples a voltage into the second multi-terminal junction of the entanglement junction.

43. (Currently amended) The system of claim 41, wherein the plate is coupled to the controller so that the controller can switchably entangle ~~the~~ a quantum ~~states~~ state of the qubit and the ~~second~~ auxiliary qubit.

44. (Currently amended) The system of claim 41, wherein the second multi-terminal junction of the entanglement junction is separated from the superconducting loop of the qubit.

45. (Original) The system of claim 41, wherein the multi-terminal junction of the entanglement junction includes a two-dimensional electron gas junction.

46. (Original) The system of claim 41, wherein the multi-terminal junction of the entanglement junction includes a tunneling junction.

47. (Original) The system of claim 41, wherein the multi-terminal junction of the entanglement junction includes a constriction junction.

48. (Currently amended) The system of claim 1, wherein the multi-terminal junction is a ~~3-terminal~~ three-terminal junction.

49. (Original) The system of claim 1, wherein the multi-terminal junction is a four-terminal junction.

50. (Original) The system of claim 1, wherein the multi-terminal junction is a five-terminal junction.

51. (Original) The system of claim 1, wherein the multi-terminal junction is a six-terminal junction.

52. (Original) The system of claim 1, wherein the multi-terminal junction includes more than six terminals.

53. (Currently amended) The system of claim 1, wherein the qubit is coupled to a plurality of ~~other~~ qubits to form a qubit array.

54. (Currently amended) The system of claim 53, wherein the multi-terminal junction of the qubit is shared with other qubits ~~of the qubit array~~ in said plurality of qubits.

55. (Currently amended) The system of claim 53, wherein the multi-terminal junction of the qubit is coupled to a multi-terminal ~~junctions~~ junction that ~~are~~ is not included in other qubits in said plurality of qubits.

56. (Currently amended) The system of claim 1, wherein the qubit is coupled to a plurality of other qubits to form a random number generator.